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Original Article

Comparison of the Effect of Lidocaine and Fentanyl in Preventing the Cardiovascular Complications of Laryngoscopy in Patients with Healthy General Condition

Mohammad Hasan Damshenas, Masoud Ghanei, NavidKalani, Ahmad Rastgarian*

Anaesthesiology, Critical care and pain management research center, Jahrom University of Medical Sciences, Jahrom, Iran.

Abstract

Introduction: Laryngoscopy and tracheal intubation increase sympathetic activity;thus, they may be harmful for ischemic heart disease patients or for those with high blood pressure.To reduce the hemodynamic changes induced during laryngoscopy and intubation, unlike the majority of previous studies, this study conducted a comprehensive comparison between fentanyl, lidocaineand the control group in preventing the cardiovascular complications of laryngoscopy. As a new topic, the prevalence of cardiac arrhythmias was also studied.

Materials & method: 159 patients classified by the American Society of Anesthesiologists (ASA) as physical statusI or II were randomly divided into three 53-member groups including: A, B and C.The age range was 20-60 and all the patients were candidates for general surgery. The group A or the control group received normal saline and 1.5 mg/kg lidocaine and2 microgram/kg fentanylwere respectively injected intravenously to groups B and C.Premedications, anesthetic induction and anesthetic drugs were similar for all the three groups.The heart rates and the systolic and diastolic blood pressure of all patients in the three groups were measured and recorded, before induction of anesthesia, after induction of anesthesia, immediately after laryngoscopy and 1,2,3,4,5,7,10 minutes after laryngoscopy and possible arrhythmias were also recorded.

Results: There was no significant difference between demographic data in the three groups (P> 0.05).Immediately after laryngoscopy and at other control times, lidocaine and fentanyl were effective in controlling the heart rates and systolic and diastolic blood pressure levels and significant differences were observed compared with the control group (P <0.05).No significant difference was found between lidocaine and fentanyl in preventing cardiovascular complications (P> 0.05).The incidence of arrhythmia was significantly lower in groups B and C compared with the group A (P <0.05).

Conclusion: Intravenous injection of lidocaine and fentanyl effectively reduces cardiovascular complications of patients undergoing laryngoscopy as well as the incidence of cardiac arrhythmia.

Key words: Lidocaine, Fentanyl, Laryngoscopy, Cardiovascular complications

INTRODUCTION

In some surgeries, general anesthesia requires laryngoscopy and tracheal intubation.By stimulating catecholamines, laryngoscopy and tracheal intubation induce severe hemodynamic changes [1].Cardiovascular reactions to laryngoscopy were first reported 38 years ago by B.D King et al. [2] which include: increased heart rate (HR), increased systemic blood pressure (BP),increased pulmonary capillary wedge pressure (PCWP), increased pulmonary arterial pressure (PAP) and decreased left ventricular ejection fraction [3-5].Along with dramatic and rapid advances in pharmacology and anesthesiology, anesthesiologists have always tried to find techniques to create conditions similar to physiological conditions during anesthesia.Laryngoscopy and tracheal intubation are painful stimuli during the induction stage [6] and their hemodynamic changes are more likely

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Corresponding Author: Ahmad Rastgarian.Anesthesiology,critical care and pain management research center, Jahrom University of Medical Sciences, Jahrom, Iran.Tel: +989173144589. E-mail: arastgarian@yahoo.com

to occur, especially in patients who undergo laryngoscopy for more than 45 seconds [7].Such changes are especially dangerous in patients with cardiovascular and cerebrovascular complications and can lead to myocardial infarction and intracerebral hemorrhage (ICH) [8-10].Cardiovascular complications of laryngoscopy such as increased heart rate and increased blood pressure can increase the heart's need for oxygenand this may lead to adverse consequences inthose with cardiovascular diseases. Worsening myocardial perfusion is among these consequences [11]. So far, various drugs including narcotics, local anesthetics, calcium channel blockers,vasodilators, angiotensin converting enzyme inhibitors (ACE inhibitors) and sympathetic blockers have been used to modulate such hemodynamic responses and this diversity reflects the fact that an ideal drug has not been yet introduced [12]. Lidocaine and short-acting opioids (such as fentanyl) are standard drugs used to modulate hemodynamic responses following tracheal intubation [12]. To reduce the hemodynamic changes induced during laryngoscopy and intubation, unlike the majority of previous studies, this study conducted a comprehensive comparison between fentanyl and lidocaineand the control group in preventing the cardiovascular complications of laryngoscopy. As a new topic, the prevalence of cardiac arrhythmias was also studied.

MATERIALS AND METHOD

In this double blind clinical trial, male and female patients aging between 20-60 years, admitted to hospitals affiliated to Jahrom University of Medical Sciences underwent general anesthesia using endotracheal intubationprocedure. After matching the subjects for age and gender, those with the inclusion criteria were selected randomly using draw technique. Finally, the patients were randomly divided into A, B and Cgroups.Before entering the study, research conditions and possible side effects of drugs were explained to the patients, the research method wasexplained to them and written consent was obtained from the patients. Detailed information of patients was recorded. Using 100% oxygen and lying down in a supine position, patients received an anesthesia induction drug containing 0.2 mg/kgmidazolam, 0.1-0.2 mg/kg morphine, 5-6 mg/kgpantotal and 0.4-0.6 mg/kgatracurium.Patients in each of the three groups received their drugs according to Table 3-1.

The instruction and dosage of drugs prescribed to the patients:

Group	A 53 subjects	B 53 subjects	C 53 subjects
Drug	Distilled water	Lidocaine	Fentanyl
Dosage	10 Ml	1.5 mg/kg	2 microgram/kg

The drugs were injected intravenously 1 to 2 minutes after the laryngoscopy.The heart rates and possible arrhythmias are described in 10 times and blood pressure levels are described in 6 times in the following table.

Measurement times

Measurement times	
Time 1 *	Before Induction
Time 2 *	After induction
Time 3 *	Immediately after laryngoscopy
Time 4	Minute 1
Time 5	Minute 2
Time 6 *	Minute 3
Time 7	Minute 4
Time 8	Minute 5
Time 9 *	Minute 7
Time 10 *	Minute 10

*Times related to blood pressure

*Times related to blood pressure

Data was recorded in the research questionnaire by a person who was unaware of the research method.

Inclusion and Exclusion Criteria

Inclusion criteria: All the patients aged 20-60 who underwent laryngoscopy entered the study.

Table 1: Comparison of groups A and B in terms of blood pressure and heart rate

Variable	Group A	Group B	P-value
The mean systolic blood pressure	128.59±10.73	125.12±10.10	0.0298
The mean systolic blood pressure	81.78±9.14	76.01±10.39	0.003
The mean heart rate	92.34±10.96	86.27±11.46	0.0063

Table 2: Comparison of groups A and C in terms of blood pressure and heart rate

Variable	Group A	Group C	P-value
The mean systolic blood pressure	128.59±10.73	124.52±11.76	0.0227
The mean systolic blood pressure	81.78±9.14	15.27±9.40	0.0005
The mean heart rate	92.34±10.96	85.78±12.91	0.0065

Table 3: Comparison of groups Band C in terms of blood pressure and heart rate

Variable	Group B	Group C	P-value
The mean systolic blood pressure	125.12±10.10	124.52±11.76	0.7787
The mean systolic blood pressure	76.01±10.39	15.27±9.40	0.7014
The mean heart rate	86.27±11.46	85.78±12.91	0.8664

Exclusion criteria: 1. any cardiovascular disease, including hypertension, CHF, cardiomyopathy, heart valve stenosis, history of MI, ICH, CVA,vascular aneurysm, cardiac embolism, myocarditis, arrhythmias, etc.; 2. thyroid disorders (hyperthyroidism and hypothyroidism); 3. ASA III and IV;4.allcatecholamine-producing tumors, such as phenocromocytoma, carcinoid, tumors and adrenal dysfunctions;5. adrenaldysfunction; 6. renal dysfunction; 7. severe anemia; 8. the duration of laryngoscopy> 60 second and 9. patient's lack of cooperation.

The ASA is a measure of the degree of difficulty of intubation determined based on the standard presented by American Society of Anesthesiologists determined by an expert in the preanestheticexamination.The diseases listed in the exclusion criteria were determined on the basis of history and physical examination performed by an anesthetist and preoperative tests and those with such diseases were excluded from the study.

Data were analyzed using SPSS and the following tests: t-test, chi-square test and ANOVA test. P-values below 0.05 were considered statistically significant.

RESULTS

159 patients who underwent general anesthesia using endotracheal intubationprocedure were studied. 74 patients (46%) were female and the remaining 85patients (54%) were male.

The mean age ofpatients ingroup A, B and C were 44.25 ± 12.26, 47.95 ± 9.76 and 45.00 ± 8.71respectively which was not statistically significant (p= 0.1541).

There was no difference between the three groups at time 1 in terms of blood pressure levels and heart rates. Results are presented below in detail:

At time 1, the mean systolic pressure ofpatients ingroup A, B and C were 128.6 ± 14.56, 129.52 ± 11.45 and 127.41 ± 13.49 respectivelyand no statistically significant difference was observed (p= 0.7164).

At time 1, the mean diastolic pressure ofpatients ingroup A, B and C were 81.55 ± 9.5, 82.12 ± 7.18 and 80.91 ± 7.46 respectivelyand no statistically significant difference was observed (p= 0.7449).

At time 1, the mean heart rateofpatients ingroup A, B and C were 90.64 ± 15.64, 129.52 ± 11.65 and 91.47 ± 13.49 respectivelyand no statistically significant difference was observed (p= 0.7774).

There was no difference between the three groups at time 2 in terms of blood pressure levels and heart rates. Results are presented below in detail:

At time 2, the mean systolic pressure ofpatients ingroup A, B and C were 121.55 ± 13.72, 123.41 ± 10.27 and 119.32 ± 12.79respectivelyand no statistically significant difference was observed (p= 0.2358).

At time 2, the mean diastolic pressure ofpatients ingroup A, B and C were 80.12 ± 9.21, 81.62 ± 12.24and 78.59 ± 11.03respectivelyand no statistically significant difference was observed (p= 0.4507).

At time 2, the mean heart rateofpatients ingroup A, B and C were 92.46 ± 17.43,94.35 ± 10.66 and 91.27 ± 14.99 respectivelyand no statistically significant difference was observed (p= 0.5547).

There was no difference between the three groups at time 3 in terms of heart rates; however, a significant difference was observed betweenblood pressure levels. Results are presented below in detail:

At time 3, the mean systolic pressure ofpatients ingroup A, B and C were 139.52 ± 13.22, 128.55 ± 11.12 and 127.77 ± 10.65respectivelyand a statistically significant difference was observed (p= 0.000).

At time 3, the mean diastolic pressure ofpatients ingroup A, B and C were 94.41 ± 14.31, 86.74 ± 10.64and 90.34 ± 15.03 respectivelyand a statistically significant difference was observed (p= 0.0151).

At time 3, the mean heart rateofpatients ingroup A, B and C were 93.55 ± 14.22,95.41 ± 9.65and 94.31 ± 13.33 respectivelyand no statistically significant difference was observed (p= 0.7457).

There was a difference between the three groups at time 4 in terms of heart rates. Results are presented below in detail:

At time 4, the mean heart rateofpatients ingroup A, B and C were 94.64 ± 15.11,89.33 ± 10.66 and 88.41 ± 12.15 respectivelyand a statistically significant difference was observed (p= 0.0276).

There was a difference between the three groups at time 5 in terms of heart rates. Results are presented below in detail:

At time 5, the mean heart rateofpatients ingroup A, B and C were 95.10 ± 14.41,88.12 ± 11.16 and 88.01 ± 10.37 respectivelyand a statistically significant difference was observed (p= 0.0032).

Significant differences were observed between the three groups at time 6 in terms of blood pressure levels and heart rates. Results are presented below in detail:

At time 6, the mean systolic pressure ofpatients ingroup A, B and C were 128.44 ± 14.93, 122.34 ± 10.46 and 121.73 ± 16.66respectivelyand a statistically significant difference was observed (p= 0.0299).

At time 6, the mean diastolic pressure ofpatients ingroup A, B and C were 81.20 ± 15.49, 75.44 ± 14.21and 74.22 ± 12.03 respectivelyand a statistically significant difference was observed (p= 0.0252).

At time 6, the mean heart rateofpatients ingroup A, B and C were 96.51 ± 10.97, 86.14 ± 9.99 and 87.22 ± 12.49 respectivelyand a statistically significant difference was observed (p= 0.0000).

There was a difference between the three groups at time 7 in terms of heart rates. Results are presented below in detail:

At time 7, the mean heart rateofpatients ingroup A, B and C were 95.71 ± 12.00,86.02 ± 8.62 and 86.95 ± 11.36 respectivelyand a statistically significant difference was observed (p= 0.0000).

There was a difference between the three groups at time 8 in terms of heart rates. Results are presented below in detail:

At time 8, the mean heart rateofpatients ingroup A, B and C were 93.29 ± 10.88,87.01 ± 11.65 and 87.30 ± 12.44 respectivelyand a statistically significant difference was observed (p= 0.0087).

Significant differences were observed between the three groups at time 9 in terms of blood pressure levels and heart rates. Results are presented below in detail:

At time 9, the mean systolic pressure ofpatients ingroup A, B and C were 130.71 ± 12.03, 124.30 ± 11.77 and 123.66 ± 17.54 respectivelyand a statistically significant difference was observed (p= 0.0186).

At time 9, the mean diastolic pressure ofpatients ingroup A, B and C were 82.02 ± 13.57, 76.31 ± 11.20 and 75.97 ± 12.78 respectivelyand a statistically significant difference was observed (p= 0.0226).

At time 9, the mean heart rateofpatients ingroup A, B and C were 91.51 ± 11.97, 85.13 ± 9.01 and 86.4 ± 11.49 respectivelyand a statistically significant difference was observed (p= 0.0059).

Significant differences were observed between the three groups at time 10 in terms of blood pressure levels and heart rates. Results are presented below in detail:

At time 10, the mean systolic pressure of patients in group A, B and C were 128.40 ± 9.56, 123.47 ± 10.27 and 121.91 ± 14.14 respectively and a statistically significant difference was observed (p= 0.0280).

At time 10, the mean diastolic pressure of patients in group A, B and C were 81.26 ± 10.22, 75.40 ± 9.32 and 75.61 ± 10.68 respectively and a statistically significant difference was observed (p= 0.0039).

At time 10, the mean heart rateofpatients ingroup A, B and C were 90.60 ± 10.85, 84.87 ± 10.10 and 85.17 ± 10.63 respectivelyand a statistically significant difference was observed (p= 0.001).

In group A, 11 out of 53 patients experiencedcardiac arrhythmia which on average began at time 1. In group B, 7 out of 53 patients experiencedcardiac arrhythmia which on average began at time 3 and in group C, 6 out of 53 patients,experiencedcardiac arrhythmia which on average began at time 3. Thus, the incidence of arrhythmia was higher in group A, compared to the other two groups. There was no significant difference between groups B and C in terms of incidence of arrhythmia (P = 0.7935).

There was no significant difference between the three groups in terms of age and gender (P>0.05).

DISCUSSION

The association between increased heart rate and blood pressure with laryngoscopy and tracheal intubationhas beenspecified.Certainly, tracheal intubationis a critical and dangerous stage of anesthesia which can be accompanied by increased blood pressure and heart rate. Studies have shown that following the laryngoscopy and tracheal intubation, the level of blood'sandrogenic catecholamines— including epinephrine and norepinephrine—increases.The Agonist effects of epinephrine on beta 1 receptors increase the heart rate and its contractile power and thereby increase blood pressure [1].Many of these patients can tolerate such changes well.However,specialists should pay special attention to such changes, in certain groups of patients, such as those with a history of high blood pressure or myocardial ischemia or high intracranial pressure. Post-intubation reactions may include electrocardiographic (ECG) changes in the ST segment, cardiac arrhythmia, pulmonary edema and even ruptured brain aneurysm.According to some researchers, intubation is among the most risky processes during surgery, especially in coronary artery patients.Following the stimulation of upper airwayscatecholamines arereleased and thisresults in hemodynamic changes following laryngoscopy and intubation [5].Various reports from other studies have referred to the hemodynamic changes following laryngoscopy and tracheal intubation.Wolfgang et al., in a study compared two methods of conventional endotracheal intubation and combitube and showed that the latter is associated withhigher increase in blood pressure and pulse and can be dangerous for cardiovascular patients [16].Various drugs have been proposed to prevent such changes, including short-acting opioids, inhaled drugs, intravenous lidocaine etc.

Prys Robert et al. found that such reactions would not be completely eliminated even after giving 1% halothane for 5 to 10 minutes.[14] King and colleagues have suggested using deep anesthesia with ether to prevent these reactions.[15] Using intravenous fentanyl is another effective method. In a study by Martin et al., using low doses of fentanyl (1-3 μg/kg body weight) prior to laryngoscopy dramatically prevented hypertension and increased heart rate after laryngoscopy [35].In another study, using low dose of fentanyl (1 μg/kg body weight) 4 minutes before laryngoscopy along with hypnotic doses of Pentothal and Pavuloncould not prevent the increased mean arterial pressure caused by laryngoscopy and tracheal intubation; while, using a higher dose of fentanyl (10 μg/kg body weight)could only prevent the increased heart rate before laryngoscopy. In another study, using high doses of fentanyl (> 5 μg/kg body weight)decreased themean arterial pressure (MAP <70 mmHg) in 11 to 45% of cases.In another study, it was found that using either 1or 3 μg/kg of body weight, 4 minutes before laryngoscopycould not well prevent hypertension and increased heart rate after laryngoscopy.[16] Another study compared the effects of topical laryngeal lidocaine and intravenous injection of 100 mg lidocaine in two groups of eight subjectsand concluded that both methods were relatively successful in controlling post-intubation pressure reactions; however, intravenous lidocaine was more successful.

CONCLUSION

In this study, we used intravenous fentanyl and lidocaine to prevent hemodynamic changes induced by laryngoscopy and tracheal intubation. We aimed to find the best medicine for preventing cardiovascular complications.There was no significant increase in the heart rates and systolic and diastolic blood pressure levels of subjects following laryngoscopy. This confirms previous findings on the effectiveness of intravenous injection of fentanyl and lidocaine in preventing hemodynamic changes induced by laryngoscopy and tracheal intubation. It was found that intravenous injection of lidocaine and fentanyl effectively reduces cardiovascular complications of patients undergoing laryngoscopy andtracheal intubation. Statistical findings showed that there is no significant difference betweenLidocaine and Fentanyl in prevention of cardiovascular complications after laryngoscopy andtracheal intubation. The highest effectiveness of the two drugs occurred at time 3 — immediately after laryngoscopy— and an interesting point was that the incidence of arrhythmiasignificantly reduced after injection of lidocaine and fentanyl.

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